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To:	Kathryn Cerise, Site RPM USEPA, Region VIII (8EPR-SR) 1595 Wynkoop Street Denver, CO 80202
From:	Allen Medine, Ph.D., P.E. and Aileen Molloy
Date:	Friday, October 09, 2015
Subject:	Evaluation of UPCM Parcels SS-87 and SS-88 for Siting Waste Disposal Areas

Tetra Tech was asked to evaluate the additional capacity that may be available on two parcels partially occupied by the current Richardson Flat Tailings Impoundment. The parcels, SS-87 and SS-88, owned by the parent company of UPCM, are irregular in shape, bisected by a Right-of-Way, and range in topography from portions within the floodplain of Silver Creek to upland areas and the existing Richardson Flat Tailing Impoundment (Figure 1). Silver Creek is located within the Parcel SS-88 and there are several drainage features in each parcel, not including the drainages and ponds associated with the Richardson Flat Tailings Impoundment. The main Richardson Flat Tailings Impoundment is within the northern portions of both parcels (Figure 2).

For this assessment of additional waste disposal areas, other vacant portions of Parcels SS-87 and SS-88 have been delineated and evaluated against a variety of siting criteria used to select mine waste disposal areas. The area occupied by the main impoundment has not been considered for disposal of additional wastes. The areas of the Parcels SS-87 and SS-88 include P1, P2, P3, and P4 in SS-87 and P5, P6, P7, and P8 in SS-88 (Figure 3). Each of the sub-parcels were evaluated with respect to the siting criteria described below:

- **Geologic slope of native material, topography –** the topography and geology affects the foundation of the deposition area and provides the needed stability. Some of the sub-parcels represent the transition from the old historic alluvium and the upland Keetley volcanic material (highly weathered breccia), and would be considered an upland area, as it is distant from the alluvium of Silver Creek. Other sub-parcels represent current alluvium of Silver Creek transitioning to old historic alluvium, and will be more directly coupled with surface water runoff, floodplain, and wetland areas.

- **Soils composition and hydraulic conductivity –** The native soils for the majority of the parcel area, consists of weathered bedrock overlain with stiff, silty clay and gravelly clay (4'-6'). The saturated hydraulic conductivity reflects a saturated soil's ability to transmit water when subjected to a hydraulic gradient, represented by the head of water from one location to another. It is the ease by which the soil voids (pore spaces) allow water migration. A greater saturated hydraulic conductivity could lead to more significant interactions with the underlying groundwater. The saturated hydraulic conductivity varies by location in the parcels within a narrow range from 9 micrometers per second to 11 micrometers per second, except in the Silver Creek floodplain where the conductivity reaches 20 micrometers per second.

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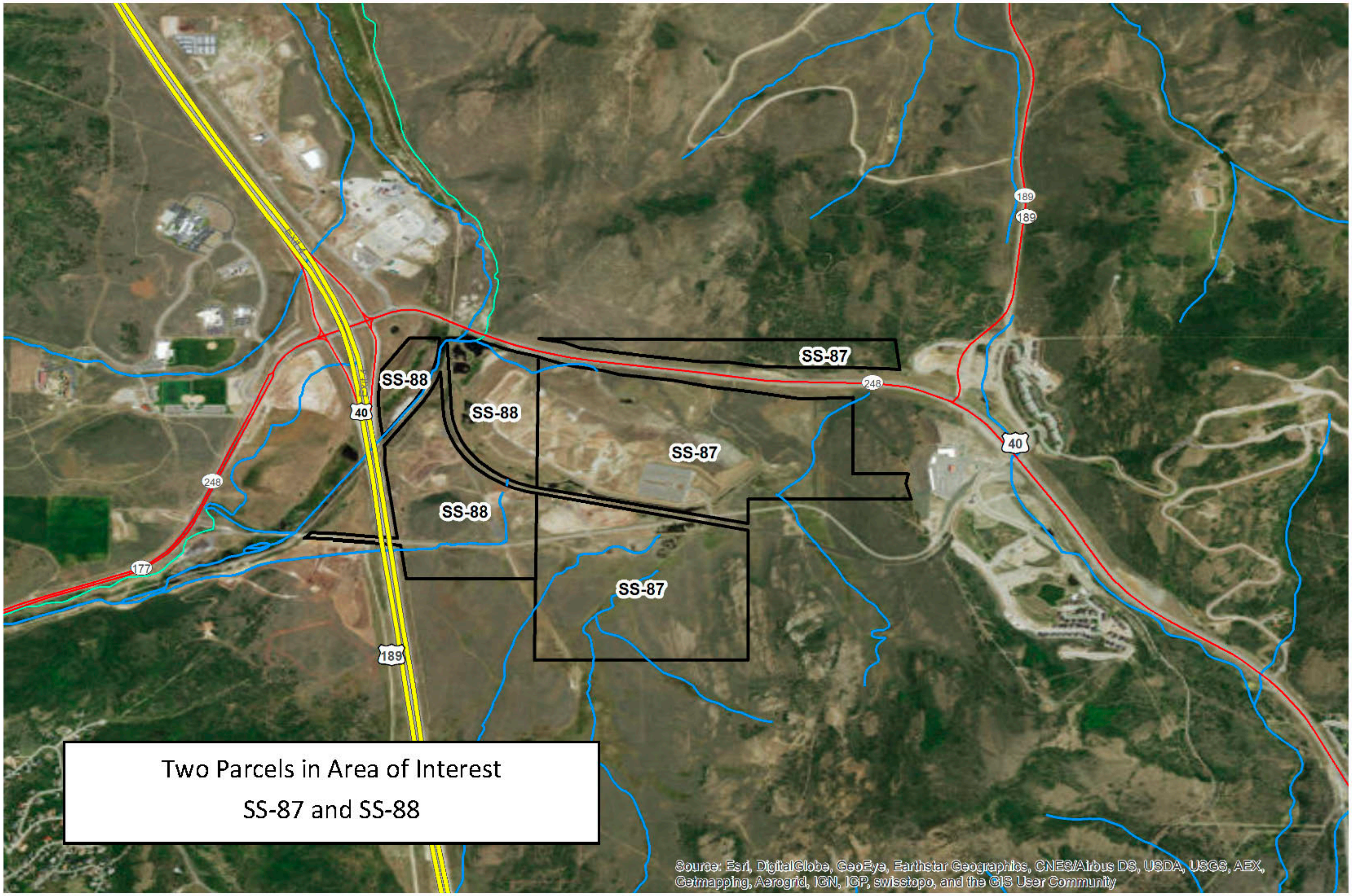

Figure 1. Location of Parcels SS-87 and SS-88 at the Richardson Flat Tailings Impoundment.

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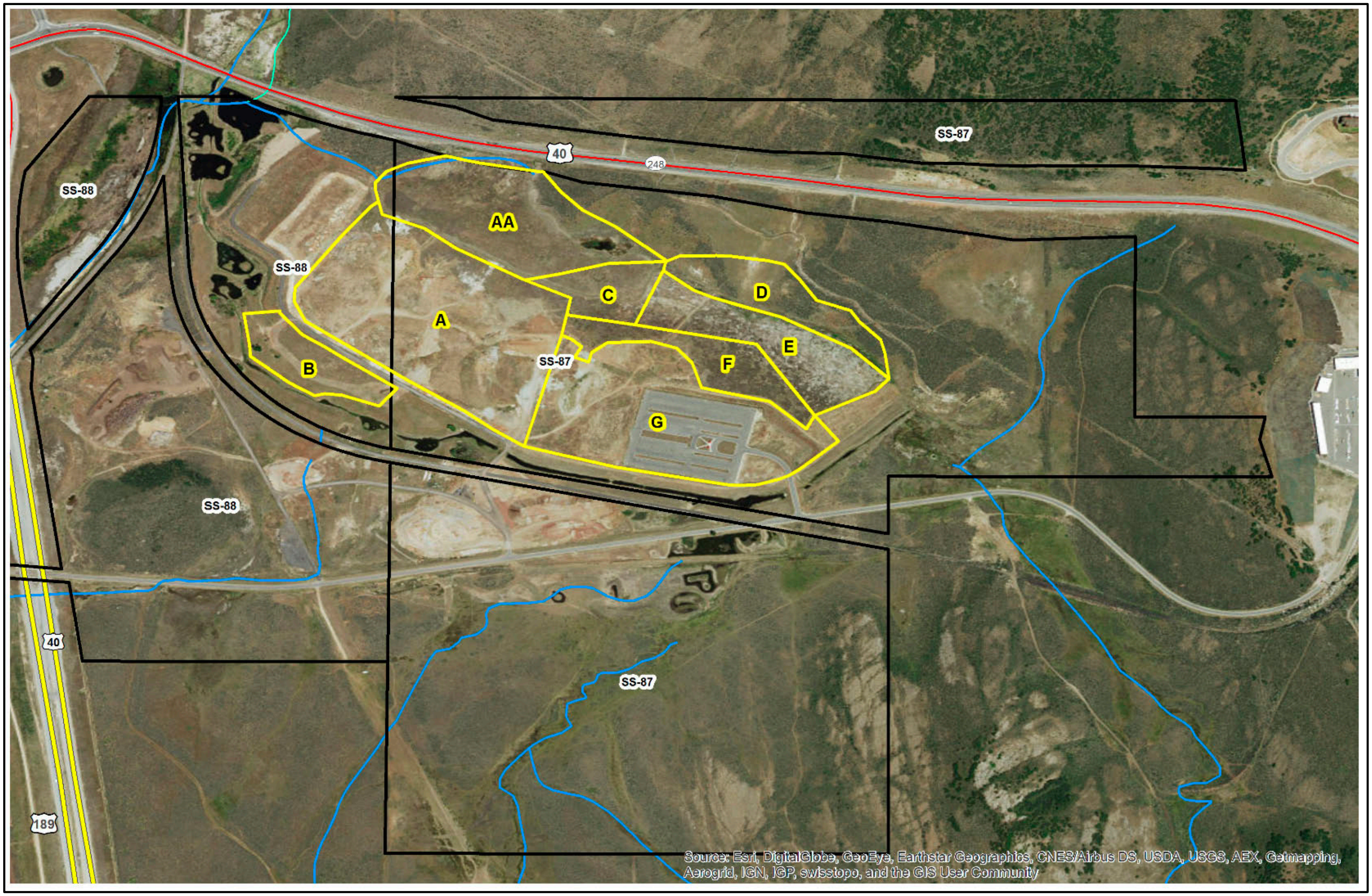

Figure 2. Richardson Flat Tailings Impoundment in the northern portions of the parcels.

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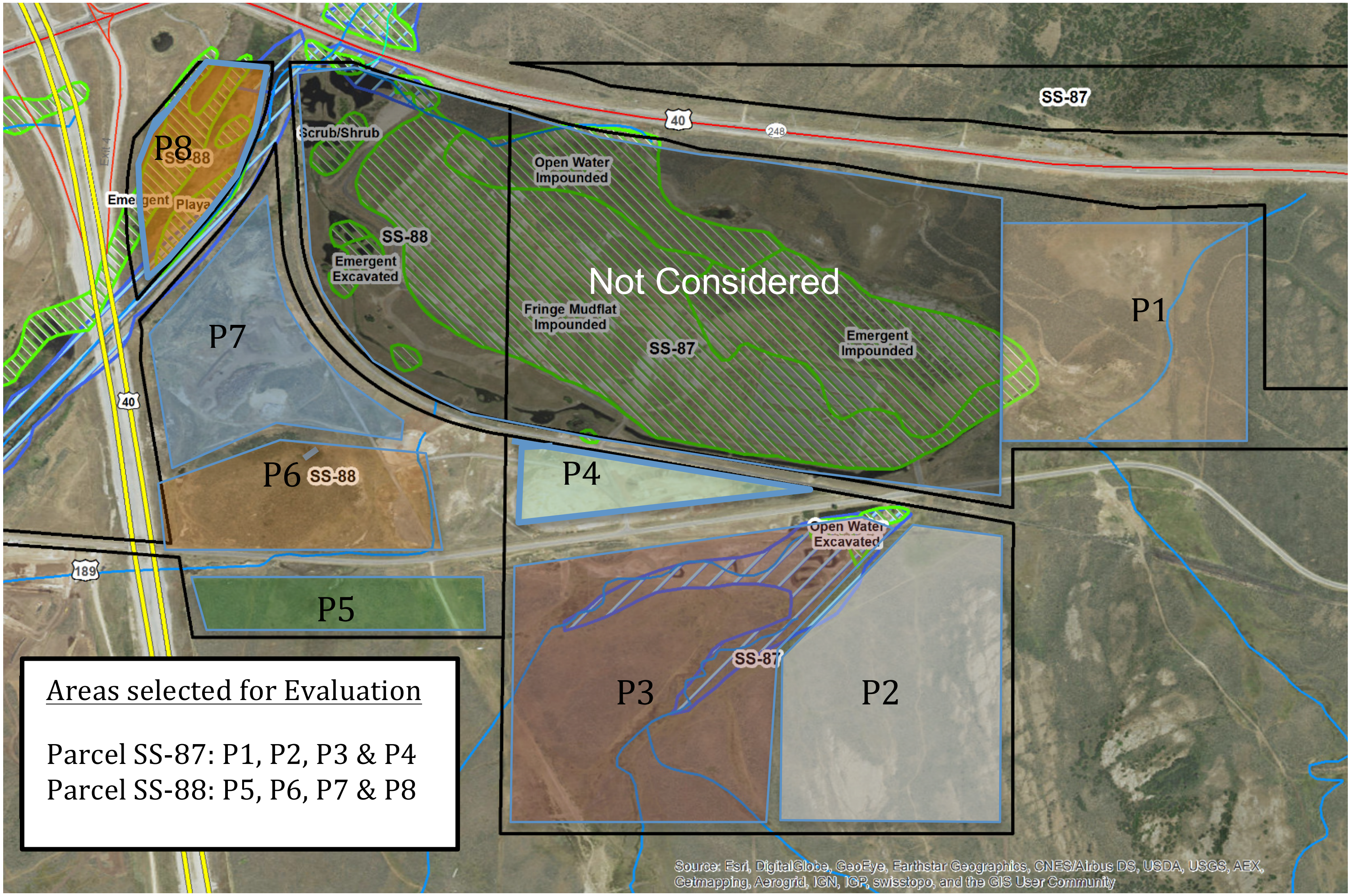

Figure 3. Portions of the main parcels that were selected for initial screening for waste disposal siting.

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- **Surface water and floodplain areas –** Sub-parcels P7 and P8 border the Silver Creek floodplain and part of the FEMA 100-year floodplain. Consequently, portions of these sub-parcels are not suitable for siting a waste repository. Placement of a waste disposal area in the portions of the parcel adjacent and outside of the 100-year floodplain could result in excessive erosion that could damage the embankment or wash out the base. In addition, sub-parcel P3 contains a large area identified as within the FEMA 100-year floodplain and would also not be acceptable, based on this one factor, for waste disposal. Disposal area siting in other sub-parcels must consider the future runoff and drainage channel capacities to ensure that the disposal area remains stable.

- **Groundwater migration and contamination –** Sub-parcels elevated about the floodplain and with a limited upgradient watershed offers the best protection against adverse interactions of a disposal area with groundwater resources. While the potential for leaching to internal and shallow groundwater with subsequent migration to the surface water diversion canals and wetlands always exists, leaching is reduced with an adequate cover with run-on controls, runoff controls and water management. With current design practices and a suitable cover material, the siting area would not lead to limited adverse effects on groundwater quality. Adequate soils cover, using the current soils, proper grading, coupled with a well drained disposal area will minimize contamination from leachate and runoff, and protect waste tailings and contaminated soils in the impoundment from settling.

- **Wildlife, vegetation, unique habitat (wetlands) –** Unique habitats located along the FEMA 100-year floodplain are provided for wildlife and aquatic organisms. Some of the sub-parcels contain disturbed soils and are not areas of sensitive habitat. With a careful design of the disposal area, impacts to existing upland habitat, following cover and revegetation, can be minimized.

- **Land use and zoning –** The Summit County zoning for the main parcels SS-87 and SS-88 is Rural Residential. Park City Municipal Corporation owns property immediately to the south of parcel SS-88 and it is designated as Open Space in current city documents.

The evaluation of sub-parcels within the Parcels SS-87 and SS-88 with respect to siting criteria requires an integrated approach, as illustrated in Figure 4. Each of the criteria is important for the screening selection of a proper location for waste disposal. In the evaluation, many criteria may be acceptable for siting but a location may be rejected due to unacceptable conditions for a single criteria. For example, conditions might be acceptable for most criteria, but the presence of the FEMA 100-year floodplain at the sub-parcel would lead to rejection of the sub-parcel. Some of the siting criteria are mapped in Figures 5a through 5f, along with the locations of Parcels SS-87 and SS-88 (Figure 3 shows the sub-parcels), and are represented by the following:

- Shaped relief from digital elevation data
- FEMA 100-year floodplain and wetlands for the parcels
- Subsurface geology for the parcels and the artificial fill
- General depth to the water table
- Saturated hydraulic conductivity
- Park City Municipal Corp. conservations easements and open space

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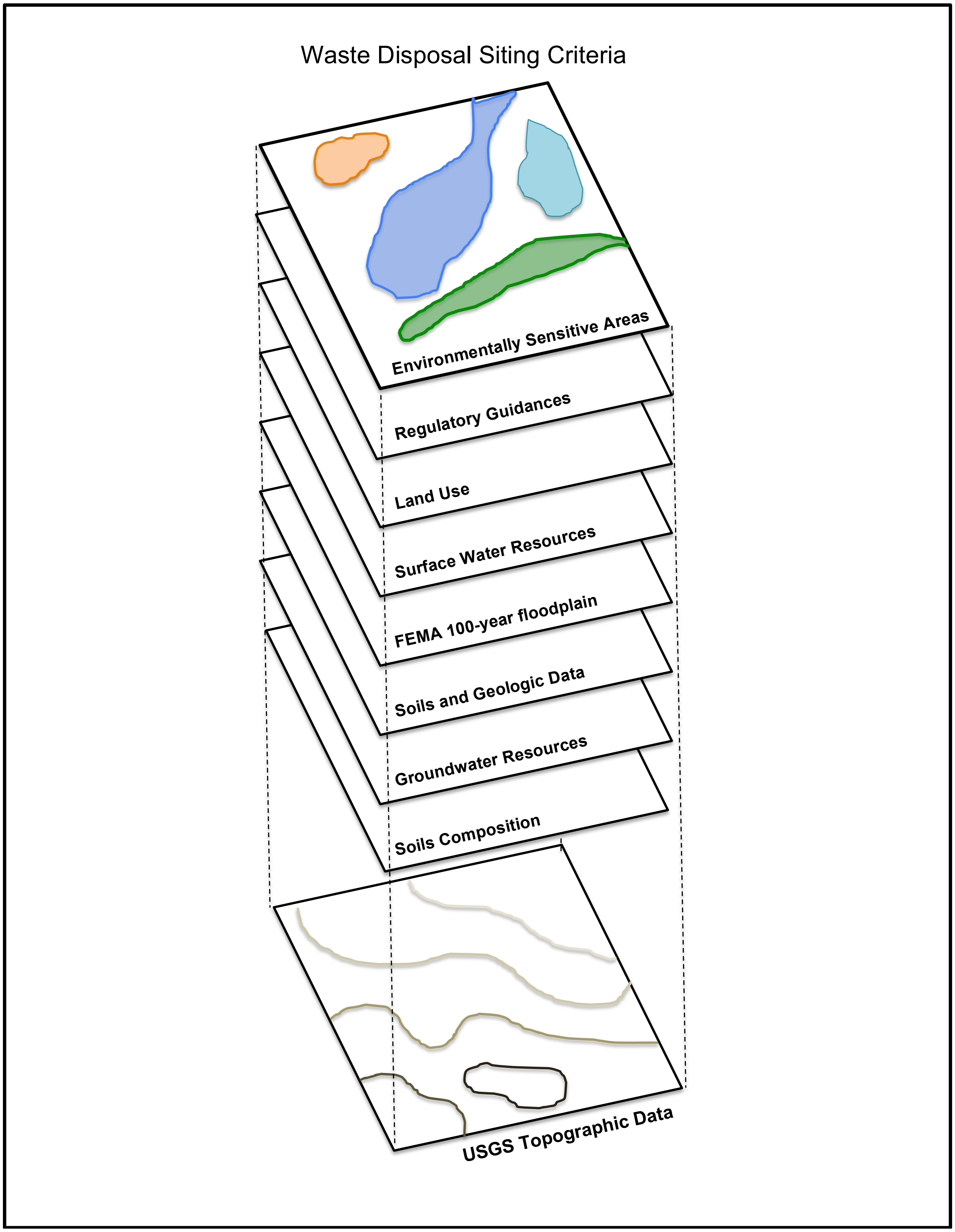

Figure 4. Integrated approach for the consideration of multiple criteria for siting a waste disposal location in various sub-parcels in Parcels SS-87 and SS-88.

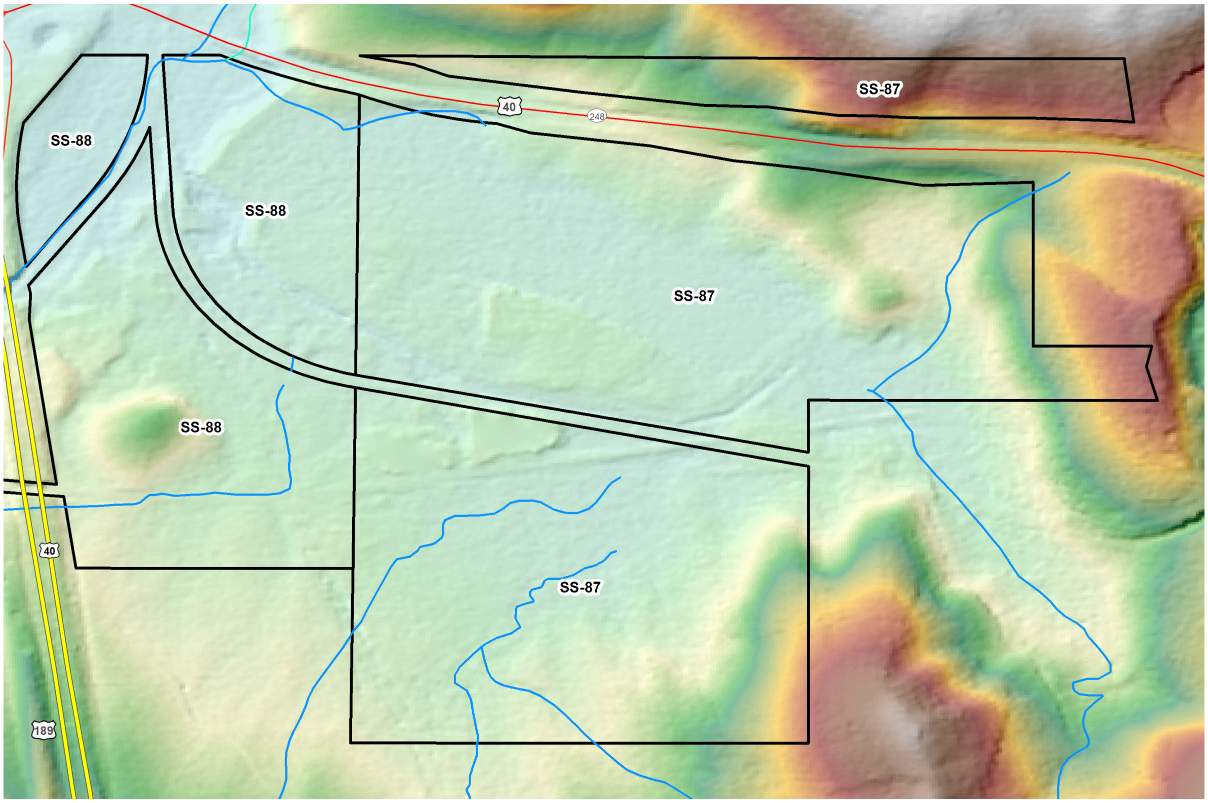

Figure 5a. Shaped relief from digital elevation data showing general topography for the parcels.

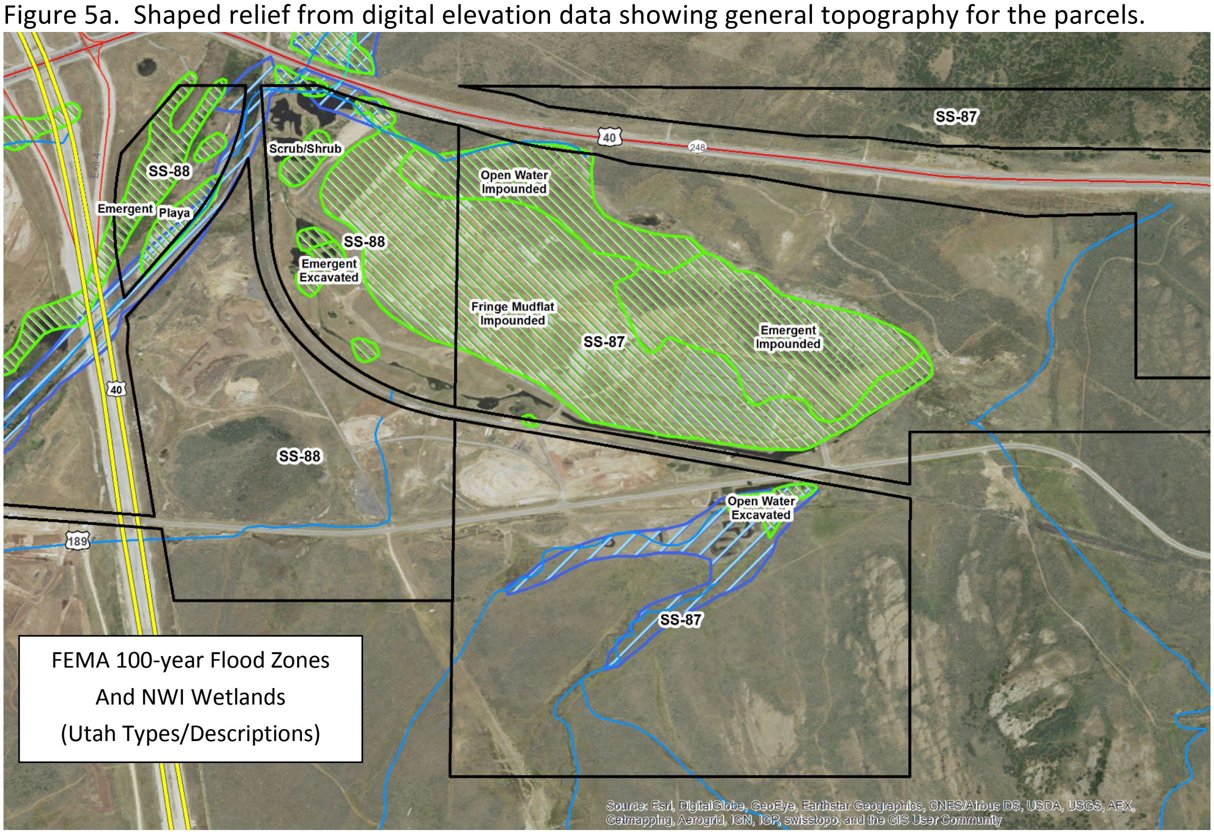

Figure 5b. FEMA 100-year floodplain and wetlands for the parcels.

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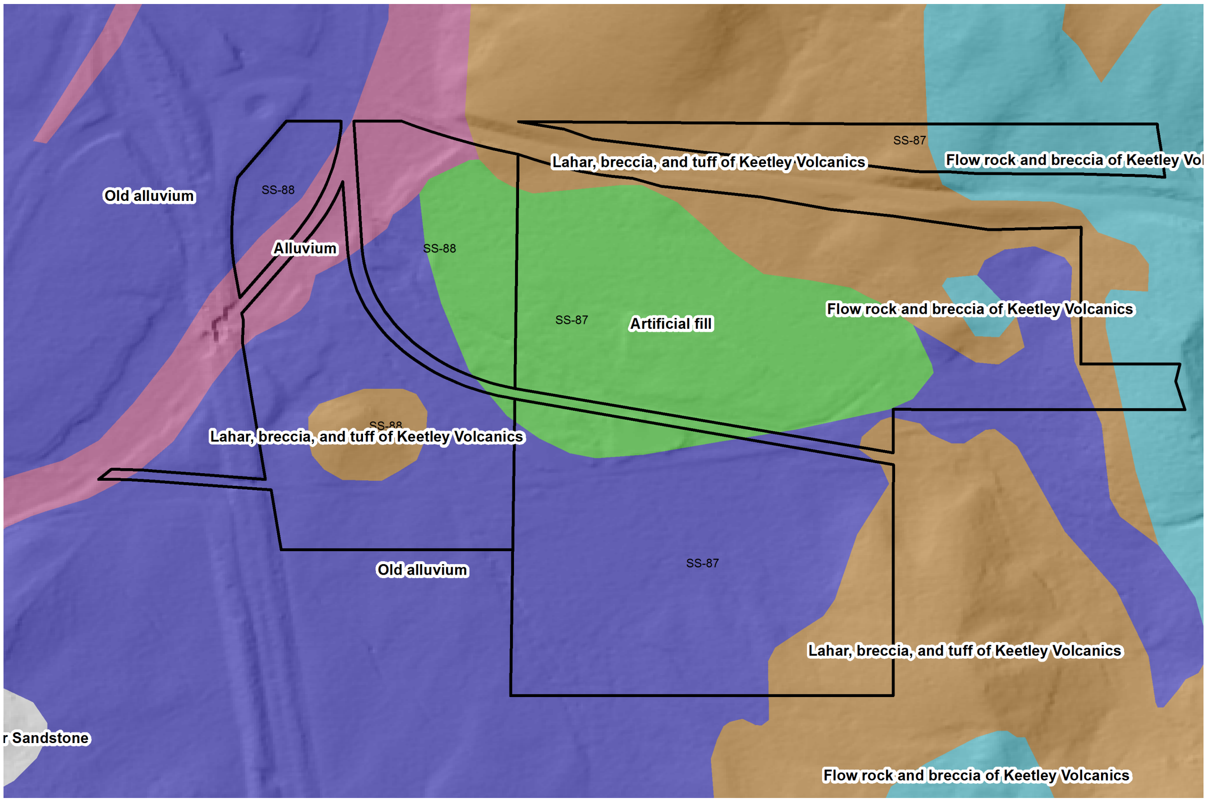

Figure 5c. Subsurface geology for the parcels and the artificial fill at Richardson Flat.

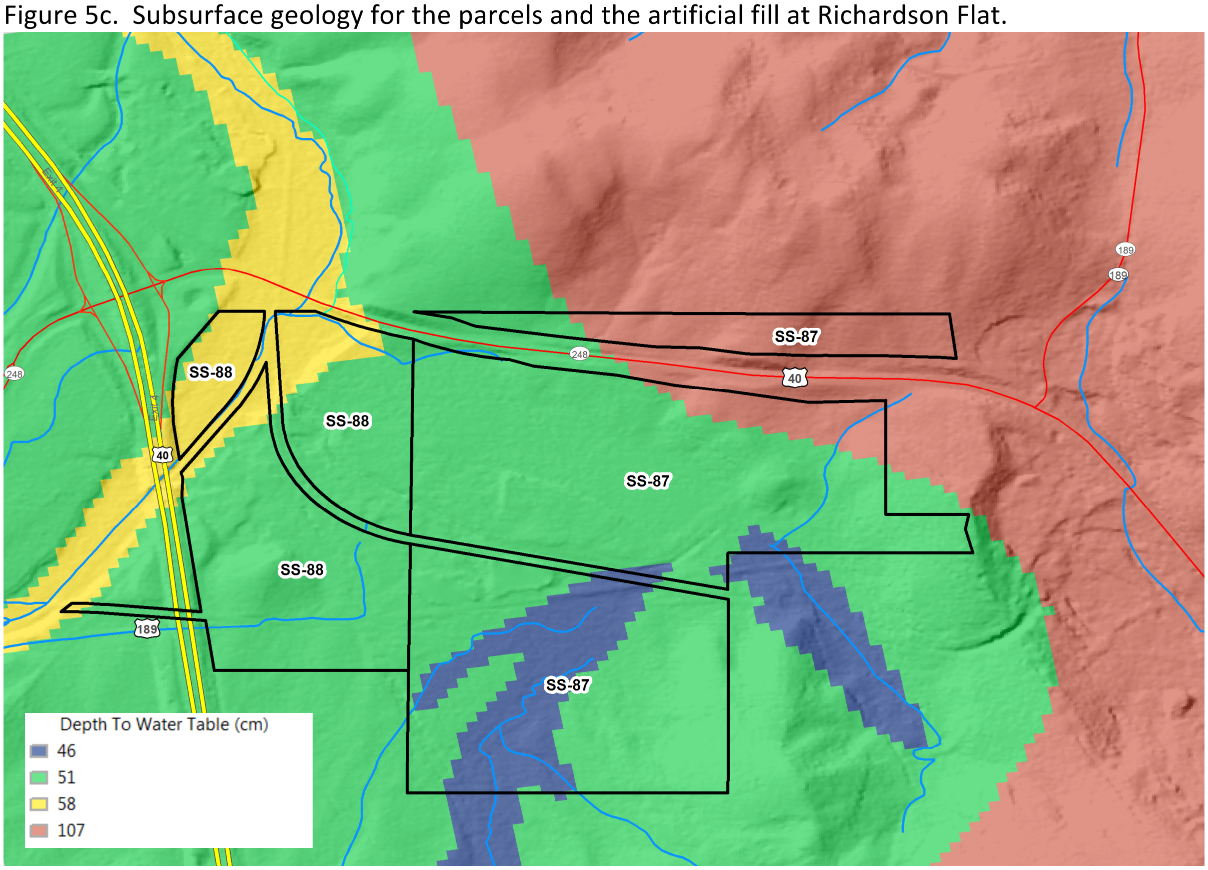

Figure 5d. General depth to the water table for the parcels.

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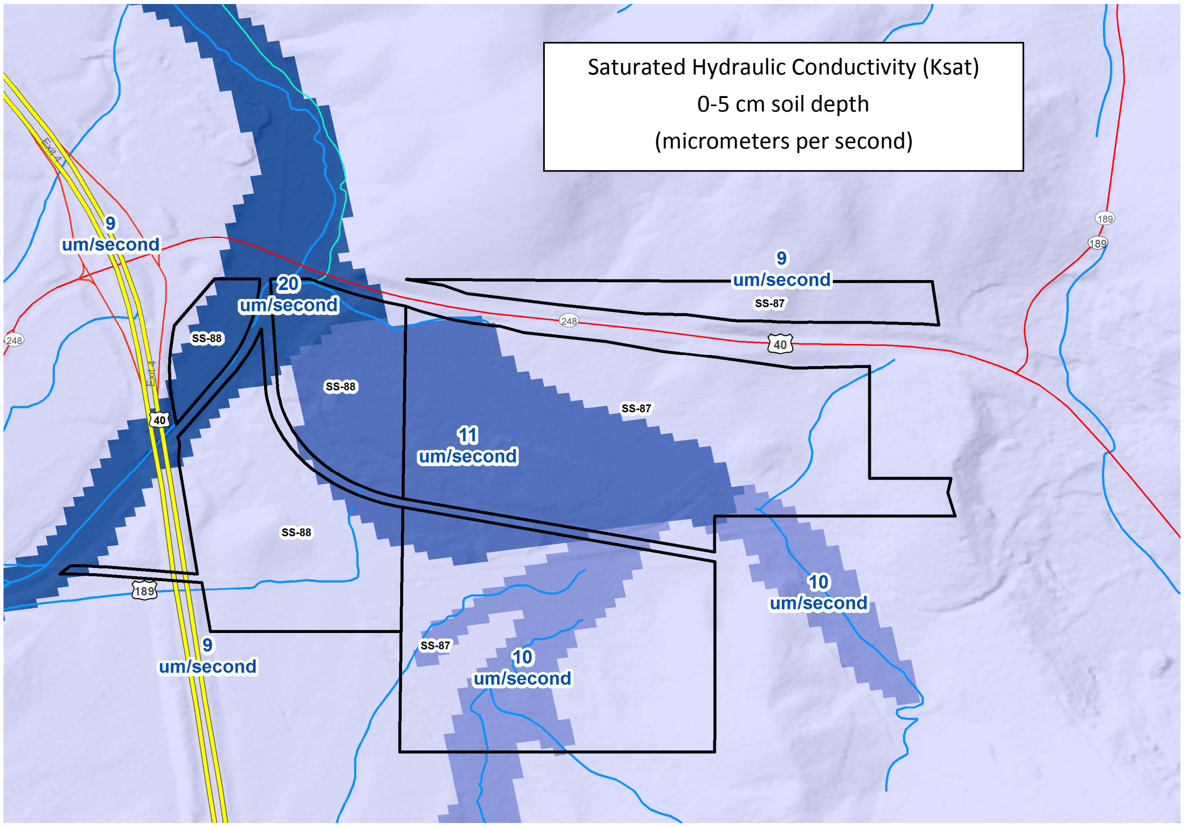

Figure 5e. Saturated hydraulic conductivity for the parcels.

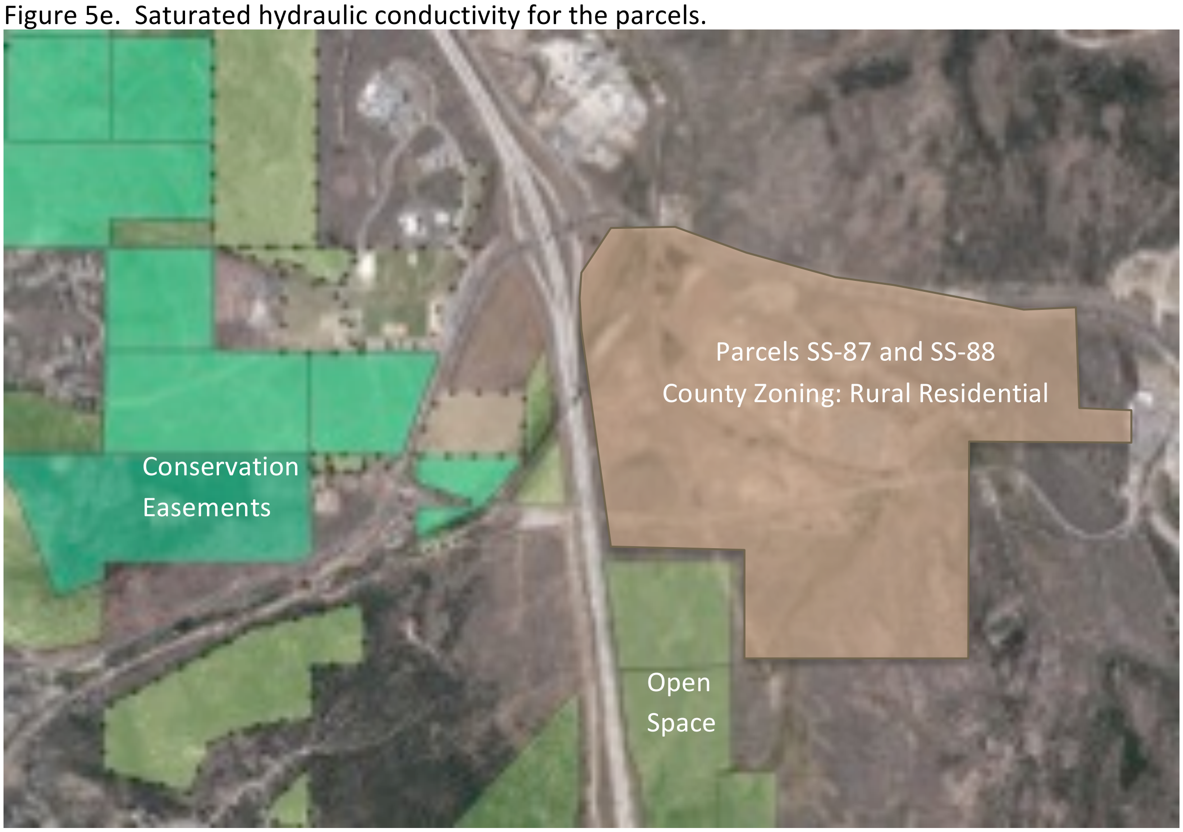

Figure 5f. PCMC conservations easements and open space in the vicinity of the parcels.

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Siting criteria were used to rank each of the sub-parcels within SS-87 and SS-88. The criteria selected for the evaluation were each assigned a value of 0-5 based on the properties or conditions within the sub-parcel to permit a quantitative ranking among the sub-parcels (A high number reflects positive conditions while a low value reflects an adverse condition relative to that criteria. The rankings for the criteria were summed to prepare an overall ranking value for each sub-parcel. The results, shown in Table 1 below, were used to select the three top sub-parcels for further evaluation and calculation of potential capacity for waste disposal.

Table 1

Parcels SS-87 and SS-88 Waste Disposal Siting Evaluation by Sub-Parcel

	Evaluation of Siting Criteria for Waste Disposal (0-5 scale) for the Sub-Parcels							
	Parcel SS-87				Parcel SS-88			
Siting Criteria	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**
Native Geologic Materials	4	5	3	0	5	3	1	3
Current Alluvial Area	5	5	3	5	5	5	4	3
Historic Alluvium	3	4	5	4	5	3	2	3
Flat Topography	2	2	4	3	4	3	3	4
Soil Composition	5	5	4	2	5	3	2	3
Saturated Hydraulic Conductivity	5	5	4	3	5	5	2	1
Surface Water Absent	5	5	1	4	5	3	4	4
Wetlands or Ponds Absent	5	5	3	4	5	5	5	1
Dry Drainages/Runoff Potential	2	4	2	4	4	2	4	2
FEMA Floodplain Absent	5	5	2	4	5	4	3	3
Upland Location	5	5	3	3	5	3	3	2
Low Potential Groundwater Interaction	3	3	2	2	3	3	2	1
Wildlife or Unique Habitat	3	3	4	4	3	3	4	1
Vehicle Access	5	5	4	5	5	5	4	3
Overall Ranking	53	56	41	47	59	47	42	31

From the ranking of the sub-parcels, P1, P2 and P5 were selected for further evaluation and capacity estimates. Details for each sub-parcel were reviewed and specific areas were selected to optimize the locations within the sub-parcel for waste disposal. Each of the sub-parcels contained one or more locations that would optimize the siting conditions and minimize potential adverse attributes of the property. In sub-parcel P1, two smaller parcels were identified: P1-A and P1-B; in sub-parcel P2, two smaller parcels were identified: P2-A and P2-B; in sub-parcel P5, only one smaller parcel was identified (Figure 5 shows the final five parcels).

Determination of Storage Capacity of Accepted Sub-Parcels. Following the delineation of the areas and a preliminary estimate of volume, more specific digital elevation data and contours were used to estimate the capacity of each area assuming two separate thicknesses for the waste disposal area of 10 ft. and 15 ft. (Table 2 contains the individual property areas and elevations). Areas P2A and P2B were treated as two impoundments with a bench area separating them to utilize the increasing topography from west to east. Slopes were conservatively set at 3:1 although changes in slope would not greatly changes the capacity estimate at this stage.

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The capacity estimates for the selected sub-parcels in total ranged from 1,350,000 to 2,000,000 depending on the depth of 10 ft. or 15 ft. (Table 3). The two areas P2A and P5 would have a capacity of 1,060,000 cubic yards with a 15 ft. thickness of wastes. The construction of the embankments, the materials, slope angles, drainage control, and internal drainage are important factors for a more detailed design, but if properly designed will produce a stable disposal environment. The results indicate that suitable locations exists within Parcels SS-87 and SS-88 for waste disposal of at least 1,000,000 cubic yards.

Table 2
Individual Property Areas and Elevations

PLOT_ID	Sub-Parcel Areas and Elevations				
	Area (sq yds)	Min elev (ft)	Max elev (ft)	Range (ft)	Mean Elev (ft)
5	43,968	6,635	6,648	13.5	6,642
1A	30,201	6,616	6,632	16.1	6,621
1B	22,648	6,655	6,672	16.4	6,663
2A	37,774	6,618	6,633	14.8	6,627
2B	20,667	6,628	6,641	13.8	6,635

Table 3
Capacity Estimates for Each Selected Area

PLOT_ID	Capacity, cubic yards	
	10' Rise Volumes	15' Rise Volumes
5	392,000	589,000
1A	235,000	351,000
1B	224,000	335,000
2A	308,000	471,000
2B	186,000	294,000
TOTAL	**1,345,000**	**2,040,000**

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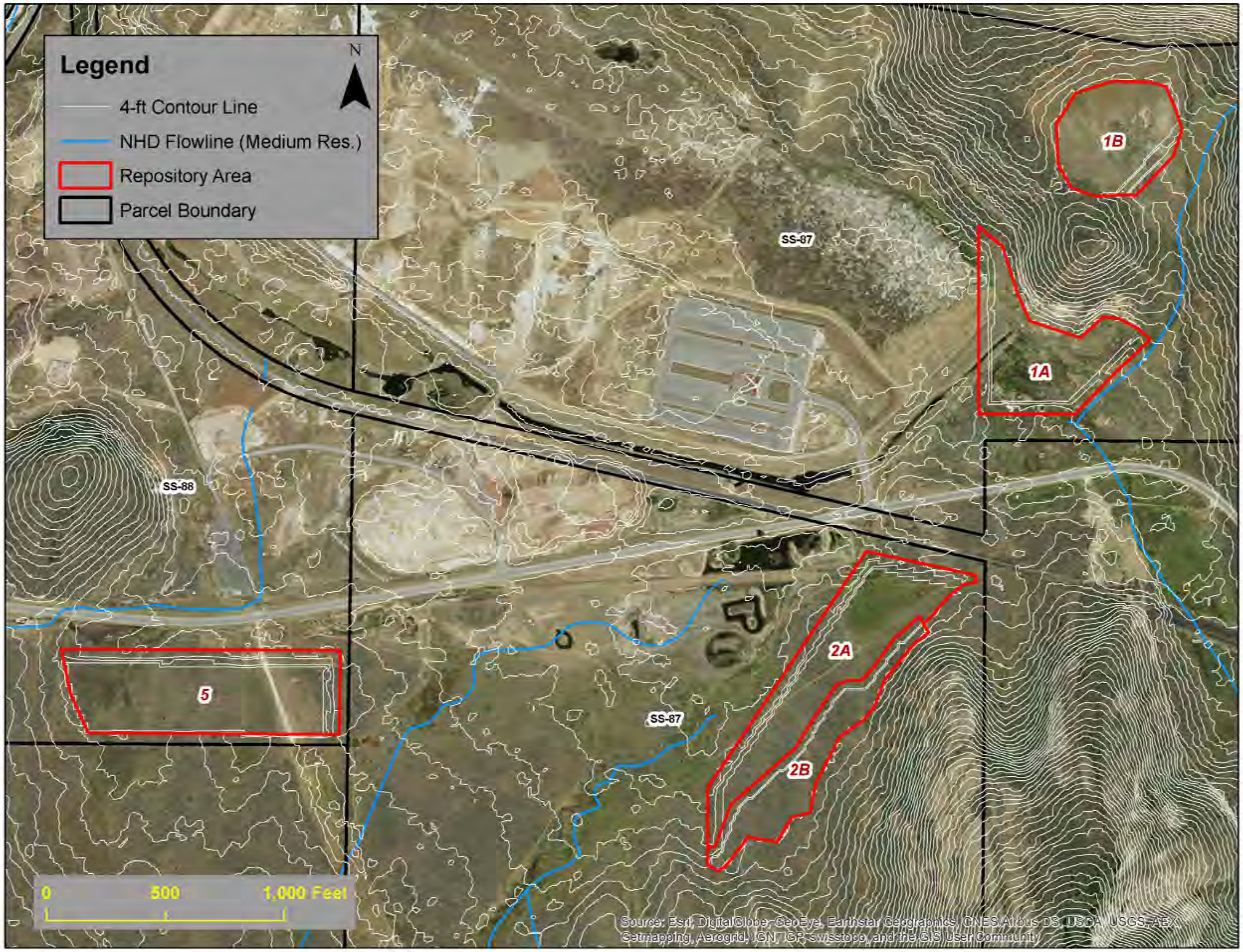

Figure 6. Portions of the Sub-Parcels selected for waste disposal and capacity estimates.

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